

SECTION 33 31 00

SANITARY SEWER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Gravity sanitary sewer pipe.
2. Sanitary manholes and appurtenances.
3. Service connections.
4. Service pipe.
5. Riser pipe.

B. Related Sections:

1. Section 31 23 33 - Trench Excavation and Backfill
2. Section 33 05 50 - Surface Facility Restoration

C. Method of Measurement:

1. Sewer Pipe:
 - a. Measure by distance in linear feet.
 - b. Measure along longitudinal axis from manhole centers with no deduction for fittings.
 - c. Measure each pipe size, class, and depth zone separately.
2. Manholes:
 - a. Measure each size and type individually as a unit.
 - b. Unit includes granular foundation, base, precast barrel and cone sections, rings, frame, and cover to a depth of 8 feet.
 - c. Measure depth from lowest invert to top of frame.
3. Extra Manhole Depth:
 - a. Measure by distance in linear feet.
 - b. Measure total distance from lowest invert to top of frame less 8 feet.
4. Manhole Drop Section:
 - a. Measure by each.
 - b. Measure from upper to lower pipe invert.
 - c. Unit includes base extension, fittings, drop pipe, collar, granular encasement, holes into manhole for drop section, and differential cost of

special lateral pipe material to a depth of 2 feet.

5. Extra Depth Drop Connection:

- a. Measure by distance in linear feet.
- b. Measure total distance from lowest invert to high pipe inlet of drop section less 2 feet.

6. Manhole Connections:

- a. Measure connections to an existing manhole as a unit.
- b. Unit includes cutting and patching of manhole wall and base, and construction of a new invert.

7. Special Fittings

- a. Measure each size and type individually as a unit.
- b. Excludes any such fitting required to be installed as a component part of any other work unit.
- c. Unit includes all materials and appurtenances necessary to install fitting as specified or directed by Engineer.

8. Service Connections: Measure fittings of each size and type as a unit.

9. Service Pipe:

- a. Measure by distance in linear feet of each size.
- b. Measure horizontally from end of riser fitting to end of pipe.

10. Riser Pipe:

- a. Measure by distance in linear feet for each size.
- b. Measure vertically from end of service wye connection fitting to end of riser fitting.

11. Trace Wire

- a. No measurement will be made for trace wire and shall be considered incidental.

12. Calcium Chloride Solution

- a. Measure by volume in gallons.
- b. Measure mixed gallons of solution applied.
- c. Measurement includes furnishing, mixing, and applying the material as specified or directed by Engineer.

D. Basis of Payment:

1. Payment for acceptable quantities of sanitary sewer items shall be at the Contract Unit Price as listed on the Bid Form.
2. All associated Work items shall be considered incidental.
3. Maintaining sanitary sewer service during construction shall be considered incidental.

1.02 REFERENCES

A. ANSI:

1. A21.4 - Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings
2. A21.11 - Standard for Rubber - Gasket Joints for Ductile Iron Pressure Pipe and Fittings
3. A21.51 - Standard for Ductile Iron Pipe Centrifugally Cast
4. A21.53 - Standard for Ductile Iron Compact Fittings, 3-inch through 16-inch

B. ASTM:

1. A48 - Specification for Gray Iron Castings
2. A74 - Specification for Cast Iron Soil Pipe and Fittings
3. C76 - Specification for Reinforced Concrete Pipe
4. C361 - Specification for Reinforced Concrete Low Head Pressure Pipe
5. C425 - Specification for Compression Joints for VCP and Fittings
6. C478 - Specification for Precast Reinforced Concrete Manhole
7. C564 - Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
8. D2321 - Recommended Practice for Installation of Flexible Thermo-plastic Sewer Pipe
9. D3034 - Specification for PVC Sewer Pipe and Fittings
10. F477 - Elastomeric Seals for Joining Plastic Pipe
11. F679 - Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
12. F714 - Specification for PE Sewer Pipe and Fittings

13. F1336 - Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings

1.03 SUBMITTALS

- A. Submit Shop Drawings for each manhole.
- B. Quality Assurance/Control Submittals:
 1. Submit Certificates of Compliance from manufacturers certifying that materials meet reference specifications listed in Article 1.02.
 2. Submit record of service connections weekly to Engineer.

1.04 HANDLING AND DELIVERY OF MATERIALS

- A. Inspect pipe and materials during unloading process and notify Engineer of cracked, flawed or otherwise defective material.

1.05 STAKING

- A. Engineer shall provide necessary staking for all work under this Section.

1.06 MAINTAINING SEWER SYSTEM

- A. Maintain flow in sanitary sewers on continuous basis while construction is underway.
- B. Plug sewers with inflatable plug. Provide pumps, portable generators, hoses, and related items appurtenant to the Work.
- C. Sewer service lines to individual users may be disconnected for a period not to exceed 3 hours.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. Provide the following:

Material	Class	Joint
PVC	SDR 35 SDR 26 Schedule 40 ASTM D3034 ASTM F477	Elastomeric Gasket Water Stop Gasket
Cement Lined Ductile Iron	Class 52 ANSI A21.4 ANSI A21.11 ANSI A21.51 ANSI A21.53	Push-On (Pipe) Mechanical (Fittings)
HDPE	SDR 17	Butt-Fusion

B. Provide pipe and fittings of each material type from same manufacturer.

C. PVC Pipe Class:

1. SDR 35 – Bury depth 0-14 feet.
2. SDR 26 – Bury depth 14-24 feet.
3. DIP CL 52 – Bury depth > 24 feet.
4. Or class as specified on Contract Documents.

D. Service Pipe:

1. 4-inch PVC
 - a. SDR 35 – Bury depth 0-14 feet.
 - b. SDR 26 – Bury depth 14-24 feet.
 - c. Schedule 40 – Bury depth > 24 feet.
 - d. Or class as specified on Contract Documents.

E. Trace Wire:

1. Insulated #10 solid core trace wire rated for underground service applications.
 - a. Color - Green

F. Service Pipe Couplings:

1. Connect to Existing Service:
 - a. Fernco, Inc., Quikseal or approved equal.
 - b. Connector model number shall be selected based on manufacturer's recommendations for pipe size and depth of service.

G. PVC Pipe Fittings:

1. ASTM D3034, F679, F1336, F477, F913.
 - a. SDR 26 wall thickness

b. Lock-in gasket

H. Cut in Saddle Fittings:

1. Romac Industries, Inc., Style "CB" Saddle or approved equal.
2. GPK PVC Saddle or approved equal for connections to PVC or VCP 10" or less mains.
 - a. Stainless steel compression straps.

2.02 TRACE WIRE

A. Copperhead Industries, LLC or approved equal.

1. #10 AWG Solid Copper Core
 - a. Rated for underground applications.
 - b. Color – Green.
 - c. Minimum 45 mil HDPE, 30 volt minimum rating.
 - d. Attached to pipe in a manner that ensured it remains intact throughout the entire installation process.

2.03 INSULATION

- A. Rigid, extruded polystyrene board insulation.
- B. Thermal Resistance (R): 5.0.
- C. Thickness: 2-inch
- D. Board Size: 48-inch by 96-inch.
- E. Compressive Strength: Minimum 25 psi.
- F. Water Absorption in accordance with ANSI/ASTM D2842: 0.1 percent by volume, maximum.
- G. Edges: Square.

2.04 MANHOLES

A. Precast Sections:

1. ASTM C478.
2. Cone: Eccentric.
3. Pipe Joints: ASTM C443, Gasketed, water-tight.
4. Minimum 48" diameter.

B. Covers and Frames:

1. ASTM A48:
 - a. Neenah R-1733- Heavy Duty, or approved equal
 - 1) Self sealing
 - a) Continuous machined dovetail groove in lid seat with 1/4" diameter neoprene gasket

- (1) Oil and weather resistant
- (2) Minimum tensile strength of 100 psi
- (3) Allowable elongation of 500%
- (4) Durometer rating of 40
- 2) 2 concealed pick holes
- 3) Stamped "Sanitary Sewer"
 - a) 2" letters

C. Adjusting Rings:

1. Reinforced concrete
 - a. Minimum 1 and maximum 4 rings
 - b. Adhesive PL-500 or approved equal between ring

D. Concrete Collar

1. Curb and gutter mix or mortar mix (Spec. 2506.2B)
 - a. Encase casting and concrete adjusting rings
 - b. 6" minimum thickness

E. Pipe Connections:

1. Precast openings
 - a. Rubber boot
 - b. Water tight
2. Field constructed
 - a. Core drilled
 - b. Rubber boot
 - c. Water tight

F. Steps:

1. Manholes shall **not** have steps, unless otherwise specified.

G. Mortar

1. ASTM C270
 - a. Pre-blended Spec Mix
 - b. Underground utility mortar containing Portland cement and hydrated lime, masonry cement or mortar cement and dried masonry sand.

2.05 DROP STRUCTURES

A. Outside Drop Structure

1. Constructed as shown on City of Richfield standard details SAN-02 (Sanitary Drop Manhole).

B. Inside Drop Structure

1. No inside drop over 2-feet allowed without prior written approval from the City Engineer.
2. Contractor shall form a concrete flume invert to match into manhole bench and invert.

PART 3 EXECUTION

3.01 PREPARATION

- A. Contractor shall notify City Engineer at least 48 hours prior to commencing any work. Contractors are subject to being shut down and or having work rejected if proper notification is not given to the City.
- B. Work shall not commence before 7:00 a.m. nor extend beyond 10:00 p.m. Monday thru Friday. On Saturdays, work hours are from 8:00 a.m. to 6:00 p.m. No work is permitted on Sundays or Holidays unless authorized by the City of Richfield. The definition of "work" also includes the starting of equipment and the delivery of materials to the job site.
- C. Line and Grade: Provide means for accurately transferring line and grade from ground surface stakes to working point in trench.
- D. Water Stops: Provide in manholes as required to prevent infiltration into system.

3.02 CONSTRUCTION REQUIREMENTS

- A. Pipe Installation:
 1. Comply with ASTM D2321 for PVC installation.
 2. Inspect pipe for defects and cracks while suspended before lowering into trench.
 3. Remove all foreign matter or dirt from the inside of the pipe and fittings prior to lowering them into position in the trench.
 4. Place pipe bell at upstream end of pipe length.
 5. Install pipe from lower to higher invert elevation at a uniform slope between manholes.

6. Fit pipe spigot ends into bell end of receiving pipe and push to "home" position.
 7. Where specified, encase joints in concrete to form a rigid watertight unit as indicated in the standard drawings.
 8. Place plug in end of incomplete piping until next pipe is lowered into trench, at end of the day and when Work stops.
 9. Provide watertight plugs at future connection plugs.
 10. When water is present in trench, seals are to remain in-place while trench is pumped completely dry.
 11. See Section 31 23 33 for pipe foundation and backfill.
 12. Maximum Allowable Deviation From Staked Grade:
 - a. Alignment: 0.30 feet.
 - b. Elevation: 0.02 percent.
- B. Connect to Existing manhole
1. Core drill and install rubber boot on all field connections to existing manholes.
 2. Reconstruct manhole invert and bench to provide unrestricted flow thru manhole to low invert.
- C. Service Wye:
1. Install mainline PVC wye at service location.
 2. Install per Standard Drawings.
 3. Where wyes do not exist on existing PVC sewer mains, remove section of sewer main and replace with PVC wye and main section by means of an approved sleeve coupling.
 4. Cut in wyes shall be core drilled to produce a uniform, smooth circular cut-out as required for proper fit.
 5. Cut out discs shall be retrieved and shall not be allowed to remain within sanitary sewer pipe.
 6. Saddle tee shall be securely fastened to the main sewer pipe by means of epoxy resin or other approved adhesive.
 7. Encase connection in concrete to a minimum thickness of six inches and as show on the Standard Drawings.
- D. Manhole Installation:
1. Place precast manhole base on compacted granular subgrade.
 2. Provide monolithic base for drop manholes.
 3. Maximum Allowable Deviation From Staked Grade:
 - a. Alignment: 0.30 feet.
 - b. Elevation: 0.03 feet.
 4. Verify top of manhole cone elevation will result in a minimum 1 and maximum of 4 adjusting rings under casting.
 5. Install casting tops to ¼" below the finished grade.
 6. Set adjusting rings and casting in a full bed of mortar. All units shall be properly fitted and sealed to form a completely water tight structure. Plaster mortar on outside of structure to a smooth surface. Strike inside mortar clean and smooth.
- E. Service Pipe:
1. Install service pipe in conformance with all applicable requirements of the main sewer installation.
 2. Install service pipe at right angles to the main sewer and at a straight line to the point of connection or termination. Bends shall not exceed 22 ½ degrees and must be deemed necessary and approved by the engineer.
 3. Extend pipe to right-of-way or easement line, as shown on the plans, or as directed by Engineer.
 4. Install pipe at minimum 2 percent or as approved by Engineer.
 5. Place water tight PVC solvent cap at end of pipe, cast iron stopper, or other cap as approved by engineer.
 6. Place service lines as deep as required to serve the property. Service Riser Sections shall be installed in accordance to the details shown on the standard drawings.
 7. Mark end of service with a 4-inch by 4-inch by 8-foot timber set 4 feet below grade.
 8. Maintain a record of each service connection as follows to be submitted to Engineer at the end of each week:
 - a. Type of service connection.
 - b. Distance from downstream manhole.
 - c. Length and elevation of service line.

- d. Ties to service connection or termination of service pipe.
- e. Length of riser.
- f. Service records shall be maintained jointly by the Contractor and Engineer on forms provided by the Engineer.
- g. Service installations shall not be backfilled until all required information has been obtained and recorded.

F. Riser Pipe:

- 1. Extend riser from service connection at 45-degree angle above horizontal to a point 11 feet below street grade.
- 2. Install riser pipe against undisturbed trench wall.
- 3. Place concrete collar around service connection as shown on Drawings.

3.03 FIELD QUALITY CONTROL

A. Remove all dirt and foreign material from pipe interior prior to testing.

B. Gravity Sewer Pipe:

- 1. Pipe Diameter 27 Inches and Smaller:
Air test.
- 2. Pipe Diameter Larger Than 27 Inches:
Infiltration test.

C. Perform the following tests upon completion of sewer construction and prior to any external plumbing connections:

- 1. Infiltration Test:
 - a. Manholes shall be watertight, with no leakage permitted.
 - b. Place 90-degree V-notch weirs in locations directed by Engineer to measure leakage in sewer lines.
 - c. Allowable leakage rate shall be 100 gallons/day/inch diameter/mile of sewer between any adjacent manholes.
 - d. Provide corrective measures for lines exceeding the allowable leakage rate.
- 2. Air Test:
 - a. Place inflatable sewer stoppers in manhole at each end of reach to be tested.
 - b. Connect 1 end of an air hose to plug used for air inlet.

- c. Connect other end of hose to portable air control equipment.
- d. This equipment consists of valves and pressure gages used to control the rate air flows to the test section and to monitor air pressure inside the pipe.
- e. Connect an air hose between compressor (or other source of compressed air) and control equipment.
- f. Add air to pipe section. Monitor air pressure so pressure inside pipe does not exceed 5.0 psig.
- g. When pressure reaches 4.0 psig, stop air supply so internal pressure is maintained for 2 minutes.
- h. These 2 minutes allow time for air temperature to come to equilibrium with the pipe walls.
- i. During this time check plugs with soap solution to detect any plug leakage. If plugs are found to leak, bleed off air, tighten plugs, and begin again by supplying air.
- j. After temperature has been allowed to stabilize for 2 minutes, disconnect air supply and allow pressure to decrease to 3.5 psig.
- k. At 3.5 psig, start stopwatch to determine time required for pressure to drop to 2.5 psig.
- l. Provide corrective measures for any line not meeting requirements.
- m. Test results are usually better if sewer pipe walls are damp at time of testing.
- n. Time shall be equal to or greater than the allowable time shown in table at end of this Section.
- 3. Deflection Test:
 - a. Perform on PVC pipe at least 30 days after trench backfill has been placed.
 - b. Perform test by pulling a mandrel through each line between manholes without aid of mechanical pulling devices.
 - c. Mandrel diameter: Minimum 95 percent of the base inside diameter of the pipe as follows:

Nominal Size (in.)	Base I.D.	5% Deflection Mandrel
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Nominal Size (in.)	Base I.D.	5% Deflection Mandrel
4	3.874	3.68
6	5.742	5.46
8	7.665	7.28
10	9.563	9.08
12	11.360	10.79
15	13.897	13.20
18	16.975	16.13
21	20.004	19.01
24	22.481	21.36
27	25.326	24.06
30	28.639	27.21
33	32.224	30.61
36	35.808	34.02
42	40.401	38.38
48	46.094	43.79

- d. The line will be considered acceptable if mandrel can progress through line without binding.
- e. Provide corrective measures for lines not meeting these requirements.

Time Required for a 0.5 PSIG Pressure Drop for Size and Length of Pipe Indicated

1 Pipe Diameter (inches)	2 Minimum Time (minutes:seconds)	3 Length for Minimum Time (feet)	4 Time for Longer Length (seconds)	Specified Minimum for Length (L) Shown (minutes:seconds)							
				100 feet	150 feet	200 feet	250 feet	300 feet	350 feet	400 feet	450 feet
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:74	57	20.942 L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:67	50	27.352 L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09

- A. Test Failure and Remedy
 - 1. In the event of a test failure on any test section, testing shall be continued until all leakage has been detected and corrected to meet the requirements.
 - 2. All repair work shall be subject to approval of the Engineer.
 - 3. Introduction of sealant substances by means of the test water will not be permitted.
 - 4. Unsatisfactory repairs or test results may result in an order to remove and replace pipe as the Engineer considers necessary for test conformance.
 - 5. All repair and replacement work shall be at the Contractor's expense.
- B. Inspection and Flushing
 - 1. Prior to final acceptance of each section of the sewer line, the Contractor shall flush an approved pipe cleaning ball, the full diameter of the sewer, through all sewer up to 24" in diameter. Larger sewers shall be cleaned by other appropriate methods.
 - 2. All dirt and debris shall be prevented from entering the existing sewer system by means of watertight plugs or other suitable methods.
 - 3. All water and debris shall be removed from system by vacuum or other approved method.
 - 4. Upon completion of the Contract, the Engineer shall carefully inspect all sewers and appurtenances. Any unsatisfactory work shall be removed and replaced in a proper manner.
 - 5. The invert of the sewer shall be left smooth, clean and free from any obstructions throughout the entire line.
- C. Televising of Lines
 - 1. All sanitary sewer lines shall be televised and the video reports submitted to the City for review.
 - 2. Video reports can be submitted on CD-ROM or DVD compact disks.
 - 3. All lines must be flushed and cleaned prior to televising.
 - 4. The video report will be used to view the condition of the sanitary sewer pipe prior to acceptance.
 - 5. Workmanship and cleanliness of the installation will be checked.
- 6. Video reports will become property of the City and contain the following:
 - a. Reference to the start and end of each video segment as it begins, by clearly identifying the manhole number where the video segment begins and the manhole number where the video segment ends.
 - b. Footages along the sewer line must be shown on the video and report and zeroed out at the beginning of each segment starting from the center of the manhole.
 - c. The video camera should be guided forward at the moderate to slow pace along the bottom of the pipe.
 - d. The camera should stop and rotate up to view each service wye.
 - e. The camera should stop at any unusual instances that are viewed while in progress and provide a more detailed and longer view of the specific instance (i.e. – bad joint, dirt in lines, settlement in line, etc.)

END OF SECTION